

### **GENERATION OF MAGMAS**

Magmas are molten rock materials that comprises three phases-solid, liquid, and vapour in the form of crystals and bubbles suspended in a medium of melt. Melting of solid rocks to form magma is controlled by three physical parameters: temperature, pressure, and composition.

The main mechanisms through which rocks melt and generate magma are-

#### **Decompression melting**

Decompression melting takes place within Earth when a body of rock is held at approximately the same temperature but the pressure is reduced. This happens because the rock is being moved toward the surface either at a mantle plume or in the upwelling part of a mantle convection cell. The reduction in overlying pressure enables the rock to melt, leading to magma formation. Decompression melting takes place as a result of less pressure being exerted on rocks.

The mechanism of decompression melting is shown in Figure 1. If a rock that is hot enough to be close to its melting point is moved toward the surface, the pressure is reduced, and the rock can pass to the liquid side of its melting curve. At this point, partial melting starts to take place.

#### **Flux Melting**

If a rock is close to its melting point and some water or CO<sub>2</sub> (a flux that promotes melting) is added to the rock, the melting temperature is reduced (solid blue line versus dotted red line), and partial melting starts.

The process of flux melting is shown in Figure 2. If the addition of water or carbon dioxide takes place deep in the earth where the temperature is already high, the lowering of melting temperature could cause the rock to partially melt to generate magma.

One place where water could be introduced is at subduction zones. Here, water present in the pore spaces of the subducting sea floor or water present in minerals like hornblende, biotite, or clay minerals would be released by the rising temperature and then move in to the overlying mantle. Introduction of this water in the mantle would then lower the melting temperature of the mantle to generate partial melts, which could then separate from the solid mantle and rise toward the surface.

#### **Crustal Anatexis**

When magmas that were generated by some other mechanism intrude into cold crust, they bring with them heat (Figure-3). Upon solidification they lose this heat and transfer it to the surrounding crust. Repeated intrusions can transfer enough heat to increase the local geothermal gradient and cause melting of the surrounding rock to generate new magmas.

Transfer of heat by this mechanism may be responsible for generating some magmas in continental rift valleys, hot spots, and subduction related environments.

Figure 1

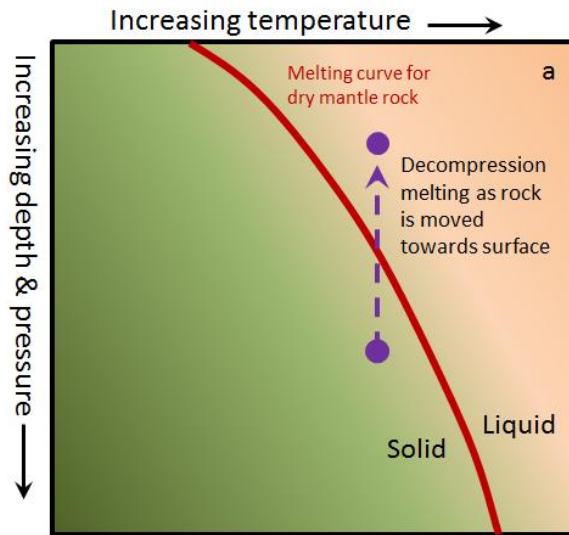


Figure 2

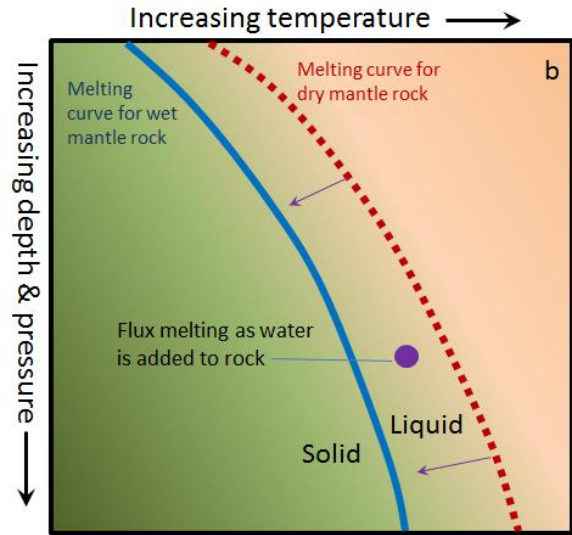


Figure 3

